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EFFECTS OF DIFFERENT LEVELS OF NPK AND CYCOCEL WITH RHIZOBIUM INOCULATION ON SOIL PHYSICO-CHEMICAL PROPERTIES OF FIELD PEA

PISUM SATIVUM L. CV. RACHNA

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Original Article

ABSTRACT

An experiment was conducted during rabi season (Nov-March) 2014-15 on "Effect of different levels of NPK and Cycocel with Rhizobium inoculation on Soil Physico-chemical properties of field pea (Pisum sativum L.) Cv. Rachna" on Research Farm SHIATS, Allahabad (U.P.). The design applied for statistical analysis was carried out with 3^2 randomized block design having three levels of N P K 50, 75, and 100 % RDF and three levels of Cycocel 0, 50 and 100 % with rahizobium inoculation 100% respectively. Treatment combination $T_8 – L_3R_1G_1$ [N: P: K 20:80:40 kg ha^{-1} + Rhizobium 2 kg ha^{-1} + Cycocel 500 ppm ha^{-1}] gave best in available nitrogen (kg ha^{-1}), available phosphorus (kg ha^{-1}) and available potassium (kg ha^{-1}), which were as 319.38, 27.46, 145.10 respectively, respectively. Treatment T_9 - $L_3R_1G_2$ [N:P:K 20:80:40 kg ha^{-1} + Rhizobium 2 kg ha^{-1} + Cycocel 1000 ppm ha^{-1}] was to be best in soil pH 7.34, EC 0.25 dsm^{-1}, bulk density 1.46 Mg m^{-3}, particle density 2.73 Mg m^{-3}, pore space 50.43 % and Organic carbon 0.87 %, which were as respectively. Soil chemical properties as available N, available K_2O, EC were found to be significant but, pH, O.C. (%), available P_2O_5 were found to be non significant. Soil physical properties as percent pore space (%) were found to be significant where as particle density (Mg m^{-3}) and bulk density (Mg m^{-3}) was found to be non significant.

KEYWORDS: Field pea, Physico-chemical, NPK, Rhizobium Inoculation, Cycocel,

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INTRODUCTION

Field pea (*Pisum sativum*) is a popular pulse crop of India. India is the second largest producer of pea in the world after Russia. Field pea is an important frost-hardy, winter-season, nutrious leguminous crop. It is extensively grown in temperature zones, but it is restricted to cooler altitudes in the tropics and winter season in the subtropics. Pulses in the world with a cultivated area of 6.33 million hectares (FAOSTAT, 2012). Field pea is grown on over 25 million acres worldwide Field pea or dry pea is marked as a dry shelled product for either human or livestock food. It is commonly used throughout the world in human diets and has high levels of amino acids, lysine and tryptophan, which are relatively low in cereal grains and contains approximately 21-25% protein. Being a legume crop and has the inherent ability to obtain much of its nitrogen requirement from the atmosphere

by forming a symbiotic relationship with *Rhizobium* bacterial Pea is a popular pulse crop of India. Pea is one of the fifth most important Pulses crops of India. The crop in the soil **(**Schatz and Endres, 2009**)**. Nitrogen fertilizer applications generally inhibit biological N-fixation by *R. leguminosarum*. The inhibitory effect of N fertilizer on nodule formation results from the fertilizer's contribution to the soil N pool. except where the amount of N applied as fertilizer plus that contained in the soil is <40 kg ha^{-1}. Small N fertilizer applications have stimulated nodule formation on pea roots in some low N environments and other pulse crops (Saikia and jain, 2007).Thus apart from meeting its own nitrogen requirement, pea crop is known to add 50-60 kg residual nitrogen ha-1 in soil (Erman *et al*., 2009). Phosphorus deficiency is usually the most important single factor for poor nodulation and low yield of leguminous crops in all soil types. The added phosphorus is reported to serve dual purpose in legumes by increasing the yield of current as well as succeeding crop. An adequate supply of phosphorus has been reported beneficial for better growth and yield, better quality and enormous nodule formation in legumes (Sammauria *et al.*, 2009). Poattissum plays more roles in a pea plant. It does not become a direct part of the plant structure, but acts to regulate water balances, nutrient and sugar movement in plant tissue, plus drives starch and protein synthesis and legume nitrogen fixation. (Saskatchewan Soil Fertility Committee, 2012) The yield and K content was measured for the seed and stover of both crops. Protein content is used as a measure of quality of pigeon pea and oil for mustard seeds. The K uptake by the crops and K balance between the crop and soil is also reported.**(**Tiwari *et al.* 2012*)*. Bio-fertilizers are known to play an important role in increasing availability of nitrogen and phosphorus besides improving biological fixation of atmospheric nitrogen and enhance phosphorus availability to crop. Therefore, introduction of efficient strains of *Rhizobium* that have a beneficial effect on the growth of legumes. Once the relationship between plant and rhizobia is established, the plant supplies the rhizobia with energy from photosynthesis and the rhizobia fix atmospheric nitrogen in the nodule, converting it into from that the plant can use. Both the plant and the rhizobia benefit from such a relationship called a symbiosis **(**Mishra *et al.*, 2010). Cycocel have been reported to reduce plant water stress and the transpiration growth rate total transpiration divided by total dry matter production (Sarathchandiran *et al.* 2007) Plants treated with Cycocel reportedly require less water, moisture increased root weight Cycocel did not affect foliage height or dry weight significantly With high soil moisture stress (Majunath *et al.* 2011) Cycocel significantly reduced transpiration per seedling and the transpiration growth ratio which implies improved water use efficiency Under low soil moisture however where efficient water use may be critical the Cycocel treated seedlings did not differ significantly from the control seedlings (Anosheh *et. al*.2014)

MATERIALS AND METHODS

Experimental Details: Treatments and Design of Layout

The experiment was conducted at crop research farm department of Soil Science Allahabad School of Agriculture SHIATS Allahabad. The experimental site is located in the sub – tropical region with 25^0 27^1 N latitude 81^0 51^1 E longitudes and 98 meter the sea level altitudes in a Randomized Block Design (R.B.D.) with nine treatments, each consisting of three replicates. The treatment consisted of inorganic source of fertilizers T_1 (50% NPK+100% R +0% Cycocel), T_2 (50% NPK+100% R +50% Cycocel),T_3 (50% NPK+100% R +100% Cycocel), T_4 (75% NPK+100% R +0% Cycocel), T_5 (75% NPK+100% R +50% Cycocel), T_6 (75% NPK+100% R +100% Cycocel), T_7 (100% NPK+100% R +0% Cycocel), T_8 (100% NPK+100% R +50% Cycocel), T_9 (100% NPK+100% R +100% Cycocel). The source of NPK and Cycocel with rhizobium inoculation respectively. The total number of plots was 27. The field pea (*Pisum sativum* L.) Cv. Rachna was sown in rabi season plots of size 2 x 2 m with row spacing 30 cm and plant to plant distance 10 cm. The crop was shown on 14th November. The treatments consisted of bioregulators Cycocel @ 0, 500, 1000 ppm flower-initiation

stages of application Control treatment was sprayed with distilled water at the same stages. Recommended dose of NPK for Field pea 20 kg N, 80 kg P_2O_5 and 40 kg K_2O/ha was applied at the time of sowing through urea, single super phosphate and muriate of potash. The jiggery was prepared by dissolving 120 g of sugar in 1000 ml of water; the solution was boiled then cooled. The Rhizobium inoculate were mixed in their respective cooled solution. The seeds were then treated with *Rhizobium Leguminosarum* (@ 20g/kg seed. The inoculated seeds were dried under shade and sown immediately after drying. All the agronomic practices were carried out uniformly to raise the crop. The crop was harvested on 15th March.

Soil Sampling

The Soil of experimental area falls in order of inceptisol alluvial in nature, both the mechanical and chemical analysis of soil was done before the starting the experiment to ascertain the initial fertility of the soil. The soil samples were randomly collected from 0-15 cm depths at randomly prior to tillage operations. The samples were mixed depth viz. and its weight was reducing by air drying, conning, quartering and passing it through 2 mm sieve. To obtain composite soil sample in respective to different depth viz. the soil was stored for mechanical chemical analysis.

Dose of N P K, Growth Regulator and Biofertilizer

100 % = $N_{20}\,P_{80}K_{40}$ kg ha^{-1}

75 % = $N_{15}\,P_{60}\,K_{30}$ kg ha^{-1}

50 % = $N_{10}\,P_{40}\,K_{20}$ kg ha^{-1}

100% Rhizobium 200g/10kg seed

100 % Cycocel = 1000 ppm ha^{-1}

50 % Cycocel =500 ppm ha^{-1}

0 % Cycocel = 0 ppm ha^{-1}

Source: Crop Management- Singh *Et Al.*, (2011)

Plant Physiology,Biochemistry And Biotechnology–Verma *Et Al.*,(2008)

Table 1: Physical Analysis of Soil

Particulars	Method Employed	Results
Sand (%)	Bouyoucous Hydrometer	60
Silt (%)	Bouyoucous **(1927)**	26
Clay (%)	-	14
Textural class	-	Sandy loam
Bulk density (Mg m^{-3})	Graduated measuring cylinder **Black (1965)**	1.23
Particle density (Mg m^{-3})	Graduated measuring cylinder **Black (1965)**	2.32
Pore Space (%)	Graduated measuring cylinder **Black (1965)**	46.98

Table 2: Chemical Analysis of Soil

Particulars	Method employed	Results
Soil pH (1:2)	Glass electrode, pH meter **(Jackson, 1958)**	7.18
Soil EC (dS m^{-1})	EC meter (Digital Conductivity Meter) **(Wilcox, 1950)**	0.19
Organic Carbon (%)	**(Walkley and Black's** method **1947)**	0.60

Table 2: Contd.,		
Available Nitrogen (kg ha^{-1})	Alkaline potassium permanganate method (**Subbaih and Asija (1956)**)	290.26
Available Phosphorus (kg ha^{-1})	Colorimetric method **(Olsen *et al*. 1954)**	25.05
Available Potassium (kg ha^{-1})	Flame photometric method **(Toth and Prince, 1949)**	157.62

Table 3: Treatment Description

Treatment	Dosage ha^{-1} in Percentage	Symbol
Levels of NPK	@ 50% NPK	L_1
	@ 75 % NPK	L_2
Levels of Rhizobium	@ 100 % NPK 100% Rhizobium	L_3 R_1
Levels of Cycocel	@ 0 % Cycocel	G_0
	@ 50 % Cycocel	G_1
	@ 100 % Cycocel	G_2

RESULTS AND DISCUSSIONS

Physical Properties

Response on bulk density, particle density and percentage pore space of soil after crop harvest. Soil Bulk density after post harvest was non-significant. The maximum Db of soil was 1.46 (Mg $m^{-3)}$ was found in T_9 (NPK @ 100% +R @ 100% + Cycocel @ 100%), followed by T_1(NPK@ 50% +sR @ 100% + Cycocel @ 0%) 1.16(Mg m^{-3}). Soil Particle density after post harvest was non-significant. The maximum Particle density of soil was 2.73 (Mg $m^{-3)}$ was found in T_9 (NPK @ 100% +R @ 100% + Cycocel @ 100%), followed by T_1 (NPK@ 50% +R @ 100% + Cycocel @ 0%) 2.43 (Mg $m^{-3)}$. Soil Pore space after post harvest was significant. The maximum of soil was 50.43 (%) was found in T_9 (NPK @ 100% +R @ 100% + Cycocel @ 100%), followed by T_1 (NPK@ 50% +R @ 100% +cycocel @ 0%) 43.63(%). The results are conformity with the finding of (Khandey *et al*.2012).

Chemical Properties

The Data on available nitrogen, available phosphorus, available potassium ,organic carbon, EC and pH revealed that the inoculation of Rhizobium, application of NPK and Cycocel increase the available Nitrogen Kg ha^{-1}, available phosphorus Kg ha^{-1}, available potassium Kg ha^{-1}, organic carbon %, EC % and pH over the T_1 (Table 5.) The application of T_9 (NPK @ 100% +R @ 100% + Cycocel @ 100% $ha^{-1)}$ gave highest EC (0.25dSm^{-1}**)**, Organic carbon (0.87 %) and pH (7.34) The lowest values were obtained from T_1 (NPK @ 50% +R @ 100% + Cycocel @ 50% $ha^{-1)}$. Highest available nitrogen 319.38 kg ha^{-1}, available phosphorus 27.46 Kg ha^{-1} and available potassium 145.10 Kg ha^{-1} was recorded with T_8 (NPK @ 100% +R @ 100% + Cycocel @ 50% $ha^{-1)}$. The lowest values were obtained from T_1 (NPK @ 50% +R @ 100% + Cycocel @ 50% $ha^{-1)}$. It is concluded from the observation that inoculation of rhizobium, NPK and Cycocel gave better response to soil; chemical properties of soil were also improved. (Bhat *et al*.2013)

Table 5: Effect of NPK and Cycocel with Rhizobium Inoculation on Soil Physico-Chemical Properties of Field Pea

Treat ment	Soil Ph	EC (Dsm^{-1})	Soil Bulk Density ($Mg\ M^{-3}$)	Soil Particle Density ($Mg\ M^{-3}$)	Soil Pore Space (%)	OC (%)	Available Nitrogen ($Kg\ Ha^{-1}$)	Available P_2O_5 ($Kg\ Ha^{-1}$)	Available K_2O ($Kg\ Ha^{-1}$)
	7.25	0.17	1.16	2.43	43.63	0.55	292.91	22.10	125.19
T_2	7.17	0.18	1.37	2.50	46.29	0.64	292.03	22.83	135.06
T_3	7.24	0.20	1.33	2.57	47.23	0.62	292.22	22.92	138.61
T_4	7.11	0.19	1.33	2.62	48.29	0.57	300.84	23.64	139.73
T_5	7.05	0.22	1.37	2.57	47.21	0.58	306.69	24.60	137.69
T_6	7.05	0.20	1.34	2.73	48.39	0.72	302.92	25.82	140.32
T_7	7.09	0.18	1.39	2.41	48.47	0.74	313.10	24.85	144.58
T_8	7.15	0.21	1.43	2.64	48.89	0.87	319.38	27.46	145.10
T_9	7.34	0.25	1.46	2.73	50.43	0.87	316.65	26.10	142.66
F-test	NS	S	NS	NS	S	NS	S	NS	S
S.Ed. (±)	0.126	0.045	0.18	0.27	0.577	0.141	5.390	0.720	10.583
C.D. (at 5%)	-	0.096	-	-	1.192	-	5.852	-	8.208

CONCLUSIONS

It is concluded that treatment combination $T_8 – L_3R_1G_1$ [N: P: K 20:80:40 kg ha^{-1} +Rhizobium 2 kg ha^{-1} + Cycocel 500 ppm ha^{-1}] gave best in available nitrogen (kg ha^{-1}), available phosphorus (kg ha^{-1}) and available potassium (kg ha^{-1}), which were as 319.38, 27.46, 145.10 respectively, respectively. Treatment T_9 - $L_3R_1G_2$ [N:P:K 20:80:40 kg ha^{-1} + Rhizobium 2 kg ha^{-1} + Cycocel 1000 ppm ha^{-1}] was to be best in soil pH 7.34, EC 0.25 ds m^{-1}, bulk density 1.46 Mg m^{-3} ,partical density 2.73 Mg m^{-3}, pore space 50.43 % and Organic carbon 0.87 %), which were as respectively. Soil chemical properties as available N, available K, EC were found to be significant but, pH, O.C. (%), and available P were found to be non significant. Soil physical properties as percent pore space (%) were found to be significant where as particle density (Mg m^{-3}) and bulk density (Mg m^{-3}) was found to be non significant.

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